Amendments to the Claims

Please amend Claims 1, 56 and 76. The Claim Listing below will replace all prior versions of the claims in the application:

Claim Listing

1. (Currently amended) A method for controlling distribution of refrigerant among a plurality of refrigerators comprising:

at a controller, determining an available quantity of the refrigerant;

at a controller, determining a demand of the refrigerant by each of the plurality of refrigerators, the demand depending on the operation of each refrigerator;

at a controller, aggregating the refrigerant demand of the refrigerators;

at a controller, determining, for each of the refrigerators, an allocation of the refrigerant based on the availability of the refrigerant, the aggregated refrigerant demand and the individual refrigerant demands of the refrigerators with respect to the other refrigerators, the allocation computed as a portion of the determined available quantity;

distributing the refrigerant to the refrigerators based on the determined allocation; and

redistributing the refrigerant over time by redetermining the allocation of the refrigerant.

2. (Original) The method of claim 1 further comprising recomputing the available quantity of the refrigerant, wherein the redistributing further comprises redistributing based on the recomputed available quantity of the refrigerant.

3. (Original) The method of claim 1 wherein the computing and recomputing the available quantity of the refrigerant further comprises computing in a master controller in communication with each of the refrigerators.

4. (Previously presented) The method of claim 1 wherein each refrigerator further comprises a slave controller operable to control consumption of the refrigerant by the refrigerator and the computing and recomputing the refrigerant demand further comprises computing in the slave controller.

5. (Original) The method of claim 1 further comprising determining a master controller state indicative of demand for and availability of the refrigerant, wherein redistributing the allocation of the refrigerant includes computing based on the master controller state.

6. (Previously presented) The method of claim 1 further comprising determining a refrigerator status and mode indicative of a refrigerant demand of each refrigerator, wherein redistributing the allocation of the refrigerant includes computing based on the refrigerator status and mode.

7. (Previously presented) The method of claim 3 wherein computing and recomputing in the master controller occurs according to a predetermined set of rules and thresholds.

8. (Previously presented) The method of claim 1 wherein computing and recomputing the refrigerant demand further comprising sensing at least one operating parameter of each refrigerator.

9. (Previously presented) The method of claim 8 wherein the at least one operating parameter includes parameters selected from the group consisting of temperature, supply pressure, return pressure, drive motor speed, and allocated helium.

10. (Previously presented) The method of claim 1 wherein the refrigerant demand is indicative of a rate of refrigerant consumption over time.

11. (Previously presented) The method of claim 1 wherein computing the allocation further comprises sensing at least one operating parameter of each refrigerator.

12. (Previously presented) The method of claim 11 wherein the at least one operating parameter is a differential pressure (DP).

13. (Original) The method of claim 1 wherein the refrigerators have variable rates of consumption

14. (Original) The method of claim 1 wherein the allocation of the refrigerant further comprises a maximum consumption rate.

15. (Original) The method of claim 5 further comprising evaluating the demand for and availability of the refrigerant, and determining the master controller state as a result of the evaluation.

16. (Original) The method of claim 15 wherein a monitor state is indicative of a sufficient allocation of the refrigerant to all of the refrigerators.

17. (Previously presented) The method of claim 15 wherein a distribution per operational demand state is indicative of at least one refrigerator having an insufficient allocation of the refrigerant.

18. (Previously presented) The method of claim 15 wherein an overload state is indicative of at least one of the refrigerators having an insufficient allocation of the refrigerant and an aggregate operational demand has reached the available supply.

19. (Previously presented) The method of claim 15 wherein a distribution per hierarchy state is indicative of selectively diverting the refrigerant away from refrigerators according to a predetermined order based on the importance of each of the refrigerators.

20. (Original) The method of claim 1 wherein redistributing further comprises incrementally increasing control parameters according to the predetermined rules.

21. (Previously presented) The method of claim 1 wherein the computing the available quantity of the refrigerant further comprises computing based on a point of equilibrium between the quantity of the refrigerant and the aggregate operational demand.

22. (Original) The method of claim 1 wherein the refrigerators are included in cryopumps.

23. (Previously presented) The method of claim 22 wherein each of the cryopumps has a first stage and a second stage, and computing the refrigerant demand further comprises reading the temperature of the first stage and temperature of the second stage and computing in response to the temperatures of the first and second stages.

24. (Original) The method of claim 1 wherein the system is a fluid supply system.

25. (Original) The method of claim 1 wherein the refrigerant is helium.

26. (Original) The method of claim 1 wherein the refrigerant is distributed from a common manifold.

27. (Original) The method of claim 1 wherein the computing and recomputing the available quantity of the refrigerant further comprises computing in a master controller in communication with each of the refrigerators.

28. (Original) The method of claim 4 wherein the slave controller is a cryopump controller.

29.-50. (Canceled)

51. (Original) The method of claim 1 wherein the computing and recomputing the available quantity of the refrigerant further comprises computing in a master controller in communication with each of the compressors

52.-55. (Canceled)

56. (Currently Amended) A method of delivering helium to a plurality of cryogenic refrigerators connected to a common refrigerant source comprising:

sensing at least one operating parameter indicative of the operating status of each cryogenic refrigerator;

computing, at a controller, from the at least one parameter and a helium supply, an allocation signal indicative of an allocation of refrigerant computed as a portion of a determined helium supply based on the operation of a particular refrigerator with respect to the other refrigerators, the allocation signal computed in response to a computed helium consumption; and

controlling a drive motor connected to each of the cryogenic refrigerators to regulate the helium consumed by the cryogenic refrigerator according to the allocation signal.

57. (Original) The method of claim 56 wherein the sensing, computing, and controlling recurs at regular, predetermined intervals according to a control loop.

58. (Original) The method of claim 56 wherein the allocation signal corresponds to units of mass flow rate.

59. (Original) The method of claim 56 wherein the common refrigerant source is a helium supply driven by a compressor.

60. (Original) The method of claim 56 wherein the cryogenic refrigerator is in a cryogenic pump.

61. (Original) The method of claim 56 wherein computing the allocation signal further comprises computing based on the temperature of the refrigerant, the computed mass flow rate of the refrigerant, the pressure and temperature of the refrigerant, and the speed of the motor.

62. (Original) The method of claim 56 wherein each of the cryogenic refrigerators is operable to perform a plurality of cryogenic functions and the allocation signal is computed based on the cryogenic function and operating parameters.

63. (Original) The method of claim 57 wherein the control loop is a closed feedback loop.

64. (Original) The method of claim 56 wherein the at least one operating parameter corresponds to the operating parameters selected from the group consisting of temperature, supply pressure of the refrigerant, return pressure of the refrigerant, pump speed, and allocated helium.

65.-75. (Canceled)

76. (Currently Amended) A method of controlling a system including:

a compressor bank including at least one compressor;

a plurality of cryogenic refrigerators supplied with refrigerant from the compressor bank, the method comprising:

identifying the refrigerant requirements of each of the refrigerators, the requirements depending on the operation of each refrigerator, and

from a controller, allocating a supply of refrigerant to the refrigerators according to the identified requirements, the allocating further comprising computing a helium allocation as a portion of a determined helium supply.

77. (Original) The method of claim 76 wherein identifying the requirements further comprises identifying the consumption of each of the cryogenic refrigerators.

78. (Original) The method of claim 77 wherein allocating further comprises allocating by controlling the speed of the drive motor as a result of a temperature threshold.

79.-81. (Canceled)